

## SECTION 02730 - SANITARY SEWER SYSTEM

### 1.0 GENERAL

1.1 Work in this Section includes all exterior sanitary sewer system and force main work on this Project.

1.2 Reference Specifications are referred to by abbreviation as follows:

- A. American National Standards Institute ..... ANSI
- B. American Society for Testing and Materials..... ASTM
- C. American Water Works Association..... AWWA
- D. Virginia Department of Transportation..... VDOT

### 1.3 Definitions

- A. Outside or exterior shall mean 5 feet beyond the perimeter of buildings, except that footing drains are included.
- B. Inside or interior shall mean inside buildings and within 5 feet of the perimeter of buildings, except that footing drains are excluded.

1.4 Separation of water lines and sanitary and/or combined sewers.

- A. Follow State Health Department "Waterworks Regulations" for separation of water mains and sewer lines.
- B. Parallel Installation
  - (1) Normal Conditions - Water lines shall be constructed at least 10' horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.
  - (2) Unusual Conditions - When local conditions prevent a horizontal separation of at least 10', the water line may be laid closer to a sewer or sewer manhole provided that:
    - (a) The bottom of the water line is at least 18" above the top of the sewer.
    - (b) Where this vertical separation cannot be obtained, the sewer shall

be constructed of ductile iron pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. Crossing

- (1) Normal Conditions - Water lines crossing over sewers shall be laid to provide a separation of at least 18" between the bottom of the water line and the top of the sewer whenever possible.
- (2) Unusual Conditions - When local conditions prevent a vertical separation described in crossing, normal conditions, paragraph above the following construction shall be used.
  - (a) Sewers passing over or under water lines shall be constructed of the materials described in parallel installation, unusual conditions - Paragraph (B) above.
  - (b) Water lines passing under sewers shall, in addition, be protected by providing:
    1. A vertical separation of at least 18" between the bottom of the sewer and the top of the water lines.
    2. Water lines passing under sewers shall, in addition, be constructed of ductile iron.
    3. That the length of the water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

D. Sewers or sewer manholes - No water pipes shall pass through or come in contact with any part of sewer or sewer manhole.

## 2.0 PRODUCTS

- A. Submit shop drawings on all products as required by New Kent County.
- B. Provide certified test results of pipe testing.

2.1 Polyvinyl-Chloride (PVC) pressure pipe and fittings for other than waterworks service shall meet the requirements of ASTM D2241. The long term pressure rating (PR) shall be 160 psi with a sustained test pressure of 340 psi. Pipe joints shall conform to ASTM D3139.

- 2.2** Polyvinylchloride (PVC) pressure pipe and fittings for other than waterworks service in sizes 4" through 12" shall meet the requirements of AWWA C900, DR-18, CL 150 except that all connections shall be made using elastomeric gasket joints.
- 2.3** Polyvinyl-Chloride (PVC) gravity sewer pipe and fittings in sizes 4" through 15" shall meet the requirements of ASTM Standard D3034 SDR 35, Type PSM with flexible elastomeric gasket seals conforming to ASTM Standard F477.
- 2.4** Polyvinylchloride (PVC) gravity sewer pipe and fittings in sizes 18 in. through 27 in. shall meet the requirements of ASTM F679 wall thickness T-1, PS 46 with flexible elastomeric seals conforming to ASTM Standard F477.
- 2.5** Polyvinylchloride (PVC) pipe for use in Directional Drilling shall be AWWA C900 CERTA-LOK as manufactured by Certain Teed Corporation.
- 2.6** Polyethylene pipe for use in Directional Drilling shall be Driscopipe HDPE, Series 4000, SDR 11 meeting the requirements of AWWA C906.
- 2.7** Ductile iron pipe shall meet requirement of AWWA/ANSI C151/A21.51 for Pressure Class 350, Special Class 52, unless otherwise indicated on the drawings. Pipe shall have cement-mortar lining and a bituminous seal coat on the exterior.
- 2.8** Flanged cast iron and ductile iron pipe shall meet the requirements of AWWA/ANSI C115/A21.15 for Pressure Class 350, Special Class 53, unless otherwise shown on Contract Drawings. Thickness class shall meet requirements of AWWA/ANSI C150/A21.50. All pipes shall have a cement mortar lining on the interior and a bituminous seal coat on the exterior.
- 2.9** Gray iron and ductile iron fittings shall meet requirements of AWWA/ANSI C110/A21.10. Pressure ratings shall be a minimum of 250 psi for fittings 12" and smaller and at least 150 psi for fittings 16" and larger, or pressure specified for adjacent piping, whichever is greater. All fittings shall be all bell, mechanical joint, or mechanical joint plain end unless otherwise approved by the Engineer. All fittings shall have a cement mortar lining on the interior and a bituminous coating on the exterior.
- 2.10** Compact ductile iron fittings shall meet requirements of AWWA/ANSI C153/A21.53 in sizes 4" through 12". 16" sizes shall conform to manufacturer's standard. All fittings shall be all bell, mechanical joint, or mechanical joint plain end unless otherwise approved by the Engineer. All fittings shall have a cement mortar lining on the interior and a bituminous coating on the exterior.
- 2.11** Mechanical joints and jointing materials shall meet requirements of AWWA/ANSI C111/A21.11.
- A. Mechanical joint retainer glands shall meet requirements of AWWA/ANSI

C111/A21.11. Glands for ductile iron pipe shall be Megalug Series 1100 as manufactured by EBAA Iron Sales Inc. or approved equal. Glands for PVC pipe shall be Megalug Series 2000 as manufactured by EBAA Iron Sales Inc. or approved equal.

- B. Locked type mechanical joints may be used where restrained joints are required.
- 2.12** Metal harnesses shall be bituminous coated galvanized rods and clamps as detailed on Drawings.
- 2.13** Push-on joint and rubber gasket shall meet requirements of AWWA/ANSI C111/A21.11.
- A. Push-on joint retainer glands shall meet requirements of AWWA/ANSI C111/A21.11. Glands for ductile iron pipe shall be Megalug Series 1700 as manufactured by EBAA Iron Sales Inc. or approved equal. Glands for PVC pipe shall be Megalug Series 1600 or 6500 (IPS) as manufactured by EBAA Iron Sales Inc. or approved equal.
  - B. Locked type restrained push-on joints may be used where restrained joints are required.
- 2.14** Flanged joints for ductile iron pipe shall meet requirements of ANSI B16.1.
- 2.15** Flanged joint gaskets shall be full face, made of 1/16 in. thick rubber, and shall meet requirements of ANSI B16.21.
- 2.16** Cement mortar lining with bituminous seal coat for cast iron pipe and fittings or ductile iron pipe shall meet requirements of AWWA/ANSI C104/A21.4.
- A. Cement mortar lining shall be standard thickness.
- 2.17** Exterior, bituminous coating for cast iron fittings and ductile iron pipe shall meet requirements of AWWA/ANSI C106/A21.6 or C151/A21.51 as applicable.
- 2.18** Gate valves shall be as follows:
- A. Non-rising stem valves, 3" thru 16", shall be resilient seated and shall meet requirements of AWWA C509. Valves shall have 250 psi working pressure. Valve ends shall be compatible with piping systems in which they are installed. Valve shall have ductile iron (ASTM A536) body, bronze mounted, bronze stem, ductile iron wedge coated with nitrile rubber. The interior and exterior of the body and bonnet shall have fusion bonded epoxy coating in accordance with ASNI/AWWA C550. Valve shall have o-ring seals and open counter-clockwise.
  - B. Non-rising stem gate valves, larger than 16", shall meet requirements of AWWA

C500. Valves shall be for at least 150 psi working pressure or pressure rating specified for adjacent piping whichever is greater. Valve ends shall be compatible with piping systems in which valves are installed. Valve shall be cast iron body, bronze mounted with double parallel disc and bronze stem. Valve shall have o-ring seals and open counter-clockwise.

C. Operators

- (1) Buried valves shall be equipped with 2" square operating nuts unless otherwise shown on the Drawings. Where nuts will be more than 48" below finished grade, extension stems shall be pin connected to valve stem. Extension stem shall raise operating nut to within 24" of finished grade.
- (2) Interior valves shall be handwheel operated except where otherwise shown on the Drawings.
- (3) Interior valves in inaccessible locations shall be provided with chain operators as shown on the Drawings.

D. Valves shall be American-Darling, Clow, Dresser (M&H), Kennedy, Mueller, A.P. Smith (MET.), or approved equal meeting this Specification.

E. Tapping valves shall meet requirements of gate valves specified above except that seat opening shall be larger than nominal size and valve outlet end shall have mechanical joint. Inlet flange shall meet the requirements of ANSI B16.1, class 125 drilling and with MSS SP-60.

**2.19** Valve boxes shall be adjustable cast iron valve boxes of the two piece type, consisting of lid and two piece sliding extension. The word "Sewer" shall be cast or embossed on the valve box lid in letters not less than 1 inch high. Valve box shall be manufactured by Mueller Company, Richard Foundry, Tyler, or approved equal.

**2.20** Check valves 3 inches and larger shall be iron body, bronze mounted, swing check valves, meeting requirements of AWWA C508. Check valves 3 through 12 inches shall be for 175 psi non-shock cold water working pressure. Valves 14 through 24 inches shall be for 150 psi non-shock cold water. Valves shall have outside weight and lever.

A. Manufacturer shall be American Darling Valve and Manufacturing Company, Eddy-Iowa Division of Clow Corporation, Kennedy Valve Manufacturing Company, M & H Division of Dresser Industries, or G-A Industries, Inc.

**2.21** Plug Valves

A. General

- (1) Valves shall be of the non-lubricated type. Valves in sizes 12" and smaller shall be designed for a minimum working pressure of 175 psi. Valves in sizes 14" through 36" shall be designed for a minimum working pressure of 150 psi. Valves 42" and larger shall be designed for a minimum working pressure of 125 psi. Valves shall provide tight shutoff with rated pressure from either direction. Valves shall open in a counter-clockwise direction.
  - (2) Ports in valves shall be round or rectangular style. Where rectangular port valves are furnished, valves shall have a minimum flow area of 100% of corresponding port area.
  - (3) Valve bodies shall be of ASTM A-126, Class B cast iron. Valve body shall be furnished with a welded-in overlay of 90% nickel alloy content on all surfaces contacting the plug face. Sprayed, plated or screwed in seats are not acceptable.
  - (4) Plugs shall be of cast iron complying with ASTM A-126, Class B or ductile iron complying with ASTM A-126, Grade 65-45-12. Plugs shall be of one piece construction.
  - (5) Valves shall be furnished with replaceable, permanently-lubricated, sleeve-type 18-8 stainless steel bearings in the upper and lower journals. Shaft seals shall be in accordance with AWWA C-504-87.
  - (6) Valves shall be tested in accordance with AWWA C504-87, Section 5. Each valve shall be performance tested in accordance with Section 5.2 and shall be given a leakage test and a hydrostatic test as described in Paragraphs 5.3 and 5.4. The leakage test shall be applied to the face of the plug tending to unseat the valve. Certified copies of test results and Proof-of-Design testing as described in Section 5.5 shall be furnished upon request.
- B. Two-Way Valves: Two-way valves shall be of the eccentric type. Threaded ends shall meet NPT standard. Mechanical joint ends shall comply with AWWA C111-64.
- C. Three-Way Valves: Three-way valves shall be of the tapered plug type. Flanged valves shall meet ANSI B16.1 including facing, drilling and flange thickness. Valves shall be furnished with a plug to shut off one port at a time unless other arrangement is shown on the Drawings.
- D. Operators

- (1) Buried valves shall be equipped with 2" sq. operating nuts unless otherwise shown on the Drawings. Where nuts will be more than 48" below finished grade, extension stems shall be pin connected to valve stem. Extension stem shall raise operating nut to within 24" of finished grade.
- (2) Interior valves 4" and smaller in size shall be wrench operated, except where otherwise shown on the Drawings. Valves shall be capable of being converted to worm gear or automated operation without removing the bonnet or plug from the valve. Valves shall be equipped with a 2" sq. nut for use with removable levers or extended "T" handles.
- (3) Valves 6" and larger shall be right-angle, worm-gear operated and equipped with hand-wheels except where otherwise shown on the Drawings. Gear operators shall be totally enclosed, permanently lubricated. Manual operator components shall withstand, without damage, a pull of 200 lbs. on the handwheel, with buried service gear units capable of withstanding an input torque of 300 lbs. on the operating nut as required by AWWA C 504-87, Sec. 3.8.3 and AWWA C507-85, Sec. 11 Paragraph 11.9. Gear segment shall be of ductile iron, ASTM A536, Grade 65-45-12, supported on bronze bushings.
- (4) Interior valves in inaccessible locations shall be provided with valve floor-stands or chain operators as shown on the drawings.
- (5) Hydraulic, pneumatic or electric operators shall be provided, where shown on drawings.

E. Manufacturer

- (1) The valves shall be as manufactured by Keystone, DeZurik or Milliken.

**2.22** Tapping sleeves shall meet requirements of AWWA C110 for pressure ratings shown on the Drawings. Sleeves shall be built in two sections and shall be mechanical joint type with flanged outlet. The tapping sleeve shall be for the size and type of pipe shown on the Drawings.

**2.23** Flexible coupling shall be of gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two steel followers, two rubber compounded wedge section gaskets and sufficient galvanized track, head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping in which installed. Couplings shall be long style Model 253 manufactured by Dresser Manufacturing Division of Dresser Industries, Model 441 manufactured by Smith-Blair, or Model 501 manufactured by Romac.

**2.24** Flanged adapters for joining ductile iron plain-end pipe to flanged ductile iron items shall

be Style 128 or 227 as manufactured by Dresser Manufacturing Division of Dresser Industries. Flanged adaptors for joining plain end PVC Pipe to flanged ductile iron items shall be Uni-Flange Series 900. Adapter shall be rated for a water working pressure of the pipe connected and shall have a 2:1 factor of safety.

- 2.25** Dismantling joint shall be a telescoping, flanged spool piece with tie rod restraints. A minimum of 1" of telescoping movement shall be provided by the dismantling joint.
- A. Flanges shall be AWWA Class D steel ring flange compatible with ANSI Class 125 and 150 bolt circles. In sizes 3"-12", pipe shall be standard weight class per ASTM A53 with end ring and body of ASTM A536 65-45-12 ductile iron. In sizes 14"-60", pipe shall be ASTM A36 plate 1% cold expanded to size with end ring and body of ASTM A36 steel.
  - B. Gaskets shall be rubber in accordance with ASTM D2000 MBA810Z.
  - C. Nuts and bolts shall be ASTM 4588 HSLA.
  - D. Tie rods shall be high tensile steel per ASTM A193 Grade B7.
  - E. Joints shall be coated with a NSF 61 certified, holiday tested, fusion bonded epoxy.
- 2.26** Pressure gauges shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4½" white coated dial graduated from 0 to 160 psi. Gauges shall be similar to Ashcroft No. 1279.
- 2.27** Compound gauges shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4½" white coated dial graduated from -15 to 100 psi. Gauges shall be equipped with a valve cock and diaphragm isolator.
- 2.28** Air Release, Air/Vacuum, and Combination Valves (for sewer force mains greater than 2-inches):
- A. Columnar Air Valves
    - (1) The Sewage Air Release and Combination Valve shall consist of a compact tubular all stainless steel fabricated body, hollow direct acting float and solid large orifice float in H.D.P.E. – stainless steel nozzle and woven dirt inhibitor screen, nitrile rubber seals and natural rubber seat.
    - (2) The valve shall have an integral "Anti-Surge" Orifice mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure to less than 1.5x valve rated working pressure.



- (3) The intake orifice area shall be equal to the nominal size of the valve; i.e., a 6" valve shall have a 6" intake orifice.
- (4) Large orifice sealing shall be affected by the flat face of the control float seating against a nitrile rubber 'O' ring housed in a dovetail groove circumferentially surrounding the orifice.
- (5) Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice nozzle on a natural rubber seal affixed into the control float. The nozzle shall have a flat seating land surrounding the orifice so that damage to the rubber seal is prevented.
- (6) Connection to the valve inlet 2" and smaller shall be facilitated by NPT male inlet connections.
- (7) Connection to the valve inlet larger than 2" shall be facilitated by flanged ends conforming to ANSI B16.1 Class 125. Flanged ends shall be supplied with the requisite number of stainless steel screwed studs inserted for alignment to the specified standard. Nuts, washers, or jointing gaskets shall be excluded.
- (8) The Valve shall be designed for a minimum working pressure of 150 psi. Valves shall be Vent-O-Mat Series RGX.

(B) Low Profile Air Valves

Low profile air release valves, combination valves also referred to as "air release and vacuum valves" for force mains larger than 2-inches in size) for all force main sizes (2", 6", 8", and 12"), and located where indicated on Contract Drawings, shall have a conical shaped, stainless steel SAE 316 body, a seal plug assembly made from light weight non-corroding reinforced nylon, Buna-N O-rings, and stainless steel floats and internal parts (springs, washers, and stem). Valves shall have a polypropylene flushing connection on the top that is easily accessible, a body drain with ball valve at the base of the body, and be rated at the working pressure of 230 psi (tested to 350 psi). Air release only valves shall be Model S-020 as manufactured by A.R.I. Air/vacuum valves shall be Model K-020 as manufactured by A.R.I. Combination valves shall be Model D-020 as manufactured by A.R.I. .

## 2.29 Manholes

- A. Manholes shall be constructed of pre-cast reinforced concrete manhole sections in accordance with the requirements of ASTM C478 and detailed in Section 00870 - Standard Details.

- B. A maximum of two lift holes per manhole section may be provided.
- C. Provide tongue and groove type joints in manhole sections with a pre-formed groove in the tongue for placement of sealing gaskets.
  - (1) Bituminous mastic or butyl rubber gaskets shall comply with requirements of ASTM C990 or C443, respectively.
  - (2) Gaskets shall provide the sole element in sealing the joint from either internal or external hydrostatic pressure.
- D. Provide flexible pipe connections to manholes, other than acid-resistant manholes, for pipes 15 in. and smaller in size.
  - (1) Materials shall be resistant to water, sewage, acids, ozone, weathering and aging. Use neoprene conforming to ASTM C923 and stainless steel, Series 300.
  - (2) Cast or core drill openings in manholes to receive connectors. Connectors shall be suitable for field repair or replacement. Connectors not suitable for field replacement are unacceptable.
  - (3) The assembled connectors shall allow at least an 11° angular deflection of the pipe and at least one inch of lateral misalignment in any direction and be suitable for a normal variation in diameter or roundness for the pipe material used.
  - (4) Connectors shall be similar to Kor-n-Seal as manufactured by National Pollution Control Systems, Inc.
- E. Liners for acid-resistant manholes shall be of fiberglass reinforced polyester or polyvinylchloride construction and shall be installed to protect the pre-cast manhole sections from the inside base of the manhole to the base of the manhole frame.
  - (1) FRP liners shall consist of a 3/16 in. thick fiberglass reinforced polyester with a 15 mil gel coat interior surface. The polyester resin shall be similar to Dion No. 6694. Joints between sections of the liner shall be sealed in accordance with the manufacturer's instructions.
  - (2) PVC liners shall consist of polyvinylchloride plates, not less than 0.060 in. thick, with integral bonding ribs and shall be similar to Amercoat "T-Lock Amer-Plate". Joints between sections of liner shall be welded in accordance with the manufacturer's instructions.

- F. Sealant for manhole frames shall be a one-component polyurethane sealant similar to Sika "Sikaflex" Type 1a.
- G. Sealant for flexible pipe connections shall be a two-component polyurethane sealant similar to Sika "Sikaflex" Type 2c with primer Type 429.
- H. Manhole steps shall be corrosion-resistant and shall be one inch square cast iron, rubber-covered steel or aluminum. The steps shall conform to the dimensions shown in Section 00870 - Standard Details.
- I. Manhole frames and covers shall be molded of gray cast iron conforming to ASTM A48, Class 30. Castings shall be coated with a coal tar pitch varnish, to which sufficient oil has been added to make a smooth coating, tough and tenacious when cold, but not tacky or brittle. Seating surfaces between frame and cover shall be machined. The dimensions and weights shall conform to the requirements shown in Section 00870 -Standard Details.
  - (1) Standard Manhole Frame and Cover shall be similar to East Jordan Iron Works Catalog No. 1045Z2 frame and Catalog No. 1040C cover
  - (2) Vandal-proof Manhole Frame and Cover shall be similar to East Jordan Iron Works, Inc. Catalog No. 1045Z2PT frame and Catalog No. 1040CPT cover.
  - (3) Watertight Manhole Frame and Cover shall be similar to East Jordan Iron Works, Inc. Catalog No. 1045Z2PT frame and Catalog No. 1040APT cover.
- J. HDPE Adjusting Rings.
  - 1. In lieu of round concrete rings, all casting shall be raised using round High Density Polyethylene (HDPE) rings or an approved equal.
  - 2. All adjusting rings shall be injection molded-recycled HDPE - as manufactured by LADTECH, Inc. or approved equal and installed as per manufacturer's recommendations.
  - 3. All final grade adjustment of manhole covers and frame assemblies shall be completed utilizing injection molded High Density Polyethylene (HDPE) adjustment rings as manufactured by LADTECH, Inc. or an approved equal.
    - 3.1 The adjustment rings shall be manufactured from polyethylene plastic as identified in ASTM Designation D-1248 Standard

Specification for Polyethylene Plastic Molding and Extrusion Materials).

- 3.2 Material properties shall be tested and qualified for usage per the ASTM Test Methods referenced in the above ASTM standard.
- 3.3 The plastic rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers).
- 3.4 The adjustment rings shall be tested to assure compliance with impact and loading requirements per the ASSHTO Standard Specification for Highway Bridges.
- 3.5 Installation shall be per manufacture's recommendations only.
- 3.6 The annular space between the rings and cone basin, the rings, and the rings and cover frame shall be sealed utilizing sikaflex or an approved equal.
- 3.7 All adjustment for matching road grade shall be made utilizing a molded and indexed slope ring.
- 3.8 All grade rings shall be covered by a five year warranty.

### **2.30 Polymer Concrete Manholes**

- A. Polymer concrete manholes may be provided where manholes and/or pumpstation wet wells with acid resistant liners are noted on the Contract Drawings.
- B. References
  - (1) ASTM D 6783 Standard specification for polymer concrete pipe.
  - (2) ASTM F 477 Specification for elastometric seals (gaskets) for joining plastic pipe.
  - (3) ASTM C 579 Standard test method for compressive strength of chemical resistant mortars, grouts, monolithic surfacing and polymeric concretes.
  - (4) ASTM C 33 Standard specification for concrete aggregates.
- C. Quality Assurance and Manufacturer Testing
  - (1) Pipes: Pipe shall be manufactured in accordance with ASTM D 6783.

- (2) Joints: Joints shall meet the requirements of ASTM D 4161.
- (3) Three edge bearing strength:
  - (a) Pipe shall be designed to meet D load requirements of external soil and hydrostatic loads. Design strength shall be tested in accordance with the three-edge bearing test method of ASTM D 6783.
- (4) Compressive strength: Pipe shall have a minimum unconfined compressive strength of 13,000 psi when measured in accordance with ASTM C 579.

#### D. Materials

- (1) Resin: The manufacturer shall use only polyester resin systems designed for use with this particular application.
- (2) Filler: All aggregate, sand and quartz powder shall meet the requirements of ASTM C 33, where applicable.
- (3) Additives: Resin Additives, such as curing agents, pigments, dyes, fillers and thixotropic agents, when used, shall not be detrimental to the manhole.
- (4) Elastometric Gaskets: Gaskets shall be suitable for the service intended. All gaskets shall meet the requirement of ASTM F 477.

#### E. Manufacturing and Product Construction

- (1) Manholes: Manhole components shall be manufactured by the vibratory vertical casting process resulting in a dense, non-porous, corrosion-resistant, homogenous, composite surface.
- (2) Joints: The manhole components shall be connected with an elastometric sealing gasket as the sole means to maintain joint water-tightness. Joints at pipe tie-ins shall use flexible elastometric couplings.
- (3) Fittings: Cones, reducer slabs and base slabs shall be of the same material as adjoining riser sections. Fittings shall be

manufactured elastometric gaskets.

- (4) Acceptable manufacturer: Manufacturer of pipe and fittings shall employ manufacturing methods and material formulations in use for a minimum of ten years. Manufacturer shall be Amitech America, Ltd., Meyer Rohr + Schact GmbH or equal.

F. Design

- (1) Manholes shall be designed to withstand all live loads and dead loads as described shown on the Contract Drawings, and as required by the Virginia Department of Transportation for structures constructed in or adjacent to road right-of-ways. Dead loads shall include overburden load, soil side pressure and hydrostatic loading conditions.
- (2) Manholes shall be designed to resist buoyancy for the project conditions.

**2.31** Laterals

- A. Sewer laterals on new mains shall be made with integral sewer tees.
- B. Sewer laterals connecting to existing mains shall be made with Kor-N-Tee, Romac CB Sewer Saddle, or approved equal
- C. House Connection shall be made at the short turn tee wye. See Detail D-471
- D. Tracing wire shall be installed on all laterals. 12-gauge green, solid copper, insulated tracing wire must be used.

**3.0 EXECUTION**

- 3.1** Take all precautions necessary to ensure that pipe, valves, fittings, and related items are not damaged in unloading, handling and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

- A. Keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling and placing in trench. Close ends of in-place pipe at the end of any work period to prevent entry of animals and foreign material.
- B. Bed pipe as specified in Section 02225 - Trenching & Backfilling.
- E. Do not lay pipe when weather or trench conditions are unsuitable.
- F. Separation of sewer and water in accord with State requirements.

G. All ductile iron pipe 8" in diameter and smaller and all PVC pipe 12" in diameter and smaller shall be driven home by hand.

H. All lines shall be laid based on cut sheets.

**3.2** Lay gravity sewers so as to maintain a true alignment and grade as indicated on Contract Drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

A. Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends uphill.

B. Pipe Joint. Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives and similar materials as recommended by the manufacturer. Place, fit, join and adjust the jointing materials or factory fabricated joints as recommended by the manufacturer to obtain the degree of watertightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified under Section 02225 - Trenching & Backfilling, along each side of the pipe to resist forces that might tend to move the pipe off line and grade.

C. Complete backfilling as specified under Section 02225 - Trenching & Backfilling. Place backfill over the pipe immediately after the pipe has been laid.

**3.3** Install force main with a minimum depth of cover of 42 in. over the top of the pipe, where no grades are shown on the Drawings.

A. Where grades on the force main conflict with existing pipes or structures, lay force main to additional depth with a uniform vertical curve to provide proper clearance without the use of fittings. No additional payment will be allowed for additional excavation. Provide allowance for expansion as directed by Engineer.

B. Lay force main pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade.

**3.4** Joining Pipe

A. Join mechanical joint pipe as follows:

(1) Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter from the joint. Paint the bell and spigot with soap solution (half cup granulated soap dissolved in 1 gallon water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint

rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

- (2) Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that is located evenly around the joint. The gland is moved into position, bolts inserted and nuts screwed up finger tight, then tighten all nuts to torque listed below. Contractor shall provide a calibrated torque wrench for verification of torque.

Bolts Size - Inches	Torque Ft. -Lbs.
5/8	40 -60
3/4	60 -90
1	70 -100
1-1/4	90 -120

- (3) Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.
- (4) Permissible deflection in mechanical joint pipe shall not be greater than listed in AWWA C600.

B. Join push-on joint Ductile Iron pipe as follows.

- (1) Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer, to either the gasket or the spigot end of the joining pipe.
- (2) Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.
- (3) Permissible deflection in push-on joint pipe shall not be greater than 2/3 of that listed in AWWA C600.

C. Install PVC pipe in accordance with ASTM D-2321.

D. Set valves and valve boxes as follows.



- (1) Set vertically installed valves with stems in the vertical plane through the pipe axis and perpendicular to the pipe in the plane 90° to the pipe axis. Locate valves where indicated on Drawings. Thoroughly clean valves before installation. Check valves for satisfactory operation.
- (2) Equip all underground valves without gearing or operators with valve boxes. The box shall be in alignment with valve stem centered on valve nut. The valve box shall be so as not to transmit shock or stress to the valve. Set box cover flush with the finished ground surface or pavement.
- (3) House all operators or gearing of underground valves, equipped with gearing or operators, in manholes. Construct manhole to prevent transmitting any load or shock to the valve or pipe. Locate manholes and valves relative to each other in order that packing, operator, and other parts of the valve are readily accessible for minor repairs.
- (4) Valves shall be marked in non-residential easements by markers approved by the County.
- (5) All valve boxes placed in a green area (non-asphalt or concrete) must have a protective concrete ring installed around the valve box.

**3.5** Provide force main air vent valves at locations indicated on Drawings and at all high points of the mains. Install plug valve between main and air valves. Construct manholes for air and vacuum relief valves.

**3.6** Use sleeves where pipes, valves stem extensions or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be either cast iron or schedule 40 steel of sufficient size to allow sealing around pipes and clearance for valve stems or equipment. Extend vertical sleeves through slabs 1 inch above top surface.

Use cast iron sleeves with intermediate collars to anchor and provide a water stop on outside of sleeves that pass through exterior walls below grade. Pipes shall be sealed using Link-Seals or approved equal. Where Link-Seals become impractical, non-shrink grout may be considered on a case-by-case basis.

**3.7** Provide reaction anchors of concrete blocking and pipe restraints at all changes in direction of pressure pipelines and as shown on Drawings.

- A. Concrete reaction anchors shall bear against undisturbed earth and shall be of the size and shape indicated on Drawings.
- B. Use restraints as indicated on Drawings and in Details. Restraints shall either be Meg-a-Lug or approved equal OR the pipe provided shall have integral restrained joints.

**3.8** Construct service connections for sewer main to property line as follows:

- A. Place a tee wye fitting with 6-inch outlet in the sewer where service connection is to be constructed. Lay 6 inch pipe from the tee to the property line on a grade of not less than 1/4 in. per foot or lay ductile iron pipe on a grade of not less than 1/8 in. per foot. Close service connection at the property line with a water-tight threaded plug. See Section 00870 - Standard Details.
- B. Install service connections on existing sewer mains with a compression type cast iron saddle as manufactured by Pioneer or approved equal. Secure saddle to the pipe with a 24 gauge stainless steel strap and two nickel-bronze T bolts. Make connections of this type by machine tapping or cutting the pipe. Use mastic sealer type gasket to insure a water-tight connection.
- C. Determine the depth of service connections by the deepest of the following:
  - (1) Provide 5 foot cover at the edge of the road paving or 15 feet from the center line of the street.
  - (2) Provide 18 inch cover at the bottom of highway ditches unless protected by concrete ditch apron. Service lines under concrete aprons shall be constructed of Class 52 ductile iron.
  - (3) Provide 30 inch cover at the property line when property is above street.
  - (4) Provide depth necessary for a 1 percent grade if required to provide service to a property.
- D. Place clean out pipe visually above grade.
- E. Construct concrete pedestals where shown on the Contract Drawings and/or as directed by Engineer, in accordance with Section 00870 - Standard Details
- F. Provide ductile iron pipe or concrete encasement where cover over sewer is less than 3.5 feet in public roads or right-of-way.

**3.9** Stream crossings shall adhere to the following:

- A. Watertight manhole covers shall be provided when the top of the manhole is below the 100-year flood/wave elevation.
- B. Either concrete encasement shall be provided around the sewer at the crossing, or adequate cover (1 foot [minimum] in rock; 3 feet [minimum] in other material) shall be provided over the sewer at the crossing.
- C. Infiltration tests shall be conducted and will exhibit a level of "0" infiltration.

- 3.10** Manholes shall be constructed to the elevations shown on the Contract Drawings in accordance with the provisions of Section 00870 - Standard Details.
- A. Set manhole base section on bed of VDOT #57 stone to a minimum depth of 6 in. Stone shall be thoroughly compacted and carefully leveled.
  - B. Join all manhole riser and cone or flat slab top sections by the use of rubber gaskets.
  - C. Pack and brush joints in FRP lining in acid-resistant manholes with sealant to provide a watertight and acid-resistant seal. Field weld joints in PVC lining of acid-resistant manholes in accordance with manufacturer's instructions.
  - D. Install pipe stubs in manholes where called for on the Contract Drawings. All stubs shall extend 12" - 18" beyond the manhole and shall be sealed watertight with a plug or cap.
  - E. Install flexible manhole connections for all pipes sizes 8 in. to 15 in., inclusive and apply sealant to completely fill joint between manhole barrel and flexible connection for the full thickness of the manhole barrel.
  - F. Plug lift holes and repair any defects in manhole.
  - G. Sealant for adjusting rings shall be a one-component polyurethane sealant similar to Sika "Sikaflex" Type 1a.
    - (1) Rings will not be required outside of paved roadways or walkways unless called for on the Contract Drawings.
    - (2) Rings in paved roadways or walkways shall permit upward or downward adjustment of manhole frame by six inches, not to exceed 12" total.
  - H. Set manhole frame in bed of sealant. Bed shall consist of one, 3/8 in. bead laid flush with the inside edge of the frame base and another 3/8 in. bead laid flush with the outside edge of the frame base.
  - I. Bolt watertight manhole frames to manhole cone or flat slab top section as shown on the Standard Details.
  - J. Construct drop connections where called for on the Contract Drawings, per standard detail.
    - (1) Drop connection used on the sewer line shall be constructed of class 52 ductile iron pipe and fittings.

- K. Construct bench of concrete or brick and mortar.
- (1) Lowest elevation of bench shall be at the spring line of the outgoing pipe.
  - (2) Slope bench three inches toward channel for drainage.
  - (3) Where stubs or knockouts are provided for future pipe connections, bench shall be so formed.
  - (4) Use sulfate resistant cement for concrete or mortar on all acid-resistant manholes.
  - (5) Where sealant is used, bench shall not be in contact with pipe or flexible pipe connection.

- 3.11** Install detectable marking tape in all trenches containing buried sewer lines. Tape shall be installed in all trenches with a cover of 18 to 54" and a minimum clearance over the pipe lines of 18". Place tape on edge of trench toward the center of the pavement in roadways. Tape shall be made electrically conductive throughout the entire system through the use of splices of a type recommended by the manufacturer.

In addition to the marking tape, a green tracing wire of 12 gauge, solid, insulated copper shall be installed and taped directly on pressure pipe in a manner that a continuous tract results. Turn up into meter boxes every 2,000 LF if no other appurtenances (valves, hydrants, ARV's, etc.) are available within that distance.

- 3.12** Testing gravity sewer lines and manholes:

- A. Testing of gravity sewer lines shall be conducted on short sections of sewer line, i.e., between manholes, or at the end of each day's work. Provide all labor, materials, tools, and equipment necessary to make the tests. All equipment and methods used shall be acceptable to the Engineer. All monitoring gages shall be subject to calibration, if deemed necessary.
- B. Sanitary sewer lines 24 in. diameter and smaller shall be tested after backfill using a low-pressure air test in accordance with ASTM C924.
- C. Low-pressure air test:
  - (1) Summary of Method: Plug the section of the sewer line to be tested.

Introduce low-pressure air into the plugged line. Use the quantity and rate of air loss to determine the acceptability of the section being tested.

- (2) Preparation of the sewer line: Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line being tested to resist the test pressure. Give special attention to laterals. **All** laterals must be tested. Laterals that terminate in manholes can be air pressure tested or they may be included with the vacuum testing of that manhole.
- (3) Ground Water Determination: Install a 1/2 inch capped galvanized pipe nipple, approximately 12 inches long, through the manhole on top of the lowest sewer line in the manhole. Immediately prior to the line acceptance test, the ground water elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.
- (4) Procedures: Determine the test duration for the section under test by computation from the applicable formulas shown in ASTM C828. The pressure-holding time is based on an average holding pressure of 3 PSIG or a drop from 3.5 PSIG to 2.5 PSIG.

Add air until the internal air pressure of the sewer line is raised to approximately 4.0 PSIG. After an internal pressure of approximately 4.0 PSIG is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.

When the pressure has stabilized and is at or above the starting test pressure of 3.5 PSIG, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 PSIG. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 PSIG during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 PSIG drop has not occurred.

The test procedure may be used as a presumptive test which enables the installer to determine the acceptability of the line prior to backfill and subsequent construction activities.

If the pipe to be tested is submerged in ground water, the test pressure shall be increased 1.0 psi for every 2.31 feet the ground water level is

above the invert of the sewer.

- (5) Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.

It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. In as much as a force of 250 lb. is exerted on an 8 inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.

As a safety precaution, pressurized equipment shall include a regulator or relief valve set at perhaps 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

- D. Sanitary sewer lines larger than 24" in diameter shall be tested by infiltration or exfiltration as hereinafter detailed.

- (1) Use infiltration test when ground water is at least 4 feet above pipe crown along entire length of line to be tested. Plug the pipe at the upper manhole. Install suitable measuring device at the next lowest manhole. Measure the amount of water flowing through the outlet after flow has been stabilized.
- (2) Ground water determination: Use same procedure as "low pressure air test" above.
- (3) Use exfiltration test when ground water is less than 4 feet above the pipe crown. Conduct exfiltration test of lower manhole as detailed below. After acceptable test of lower manhole, plug the pipeline to be tested at the lower manhole. Fill the line and manhole to 4 feet above pipe crown or top of manhole whichever is less. Let the water stand until pipe has reached maximum absorption and until all trapped air has escaped, 4 hour minimum. After maximum absorption is reached, refill manhole to original level. After 30 minutes, record difference in level and convert to gallons.
- (4) Allowable leakage of the sewer shall be 50 gallons per inch of pipe diameter per mile per 24 hours.

- F. Vacuum testing of manholes: Vacuum tests shall be conducted on newly constructed manholes following construction & after all connections have been made but before any backfilling around the manhole. Successful testing shall be accomplished before any backfilling operations.

- (1) Provide necessary vacuum pump, pneumatic plugs and accessories required for proper performance of the test. Plugs shall have a sealing strength equal to or greater than the diameter of the connecting pipe to be sealed.
- (2) Follow all local, state and federal safety precautions. Brace inverts if lines entering the manhole have not been backfilled or otherwise restrained to prevent pipe from being dislodged and pulled into the manhole.
- (3) Install vacuum tester head assembly at the top access of the manhole. Adjust the cross brace to ensure that the inflatable sealing element inflates and seals against the straight top section of the manhole if possible.
- (4) Attach the vacuum pump assembly to the proper connection on the test head assembly. Make sure the vacuum inlet/outlet valve is in the closed position.
- (5) Following safety precautions and testing equipment manufacturer's instructions, inflate sealing element to the recommended maximum inflation pressure. Do not overinflate.
- (6) Start the vacuum pump assembly engine and allow preset pump to stabilize. Open the inlet/outlet ball valve and evacuate the manhole to 10" Hg (approximately -5psig). Pressurizing the manhole may result in damage to manhole or to test equipment.
- (7) Close vacuum inlet/outlet ball valve and monitor vacuum for specified test period (see table). If vacuum does not drop in excess of 1" Hg., manhole is considered acceptable and the manhole passes the test. If manhole fails the test, complete necessary repairs and repeat test procedures until satisfactory results are obtained.

Depth of Manhole (Feet)	Manhole Diameter (inches)		
	Time (seconds)		
	<u>48</u>	<u>60</u>	<u>72'</u>
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81

22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

- (8) Repeat the above test procedure after backfilling manhole for final acceptance test.

### 3.14 Force Main tests shall be as follows:

- A. Supply the pumps, water, calibrated gages and meters, and all the necessary apparatus. Notify the Department at least 48 hours in advance of the test date and perform tests in presence of Department.
- B. Hydrostatic pressure test. After the line has been backfilled and at least seven days after the last concrete anchor block was poured, a hydrostatic pressure test shall be performed. Carefully fill the system with water at a velocity of approximately 1 ft. per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 150 psi as measured at end of force main closest to sewage pump discharge. Measure pressure at lowest point in system with gage compensated for elevation. Maintain this pressure for at least two hours. No leakage will be allowed and if pressure cannot be maintained determine the cause, repair and repeat the test until successful.
- C. All visible leaks shall be repaired regardless of the amount of leakage.
- D. A leakage test shall be conducted concurrently with the pressure test. Leakage shall be determined with a calibration test meter, furnished by the Contractor. Leakage is defined as the quantity of water required to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and the pipe filled with water. Leakage shall not exceed 10 gallons per day per mile per inch of diameter. If leakage exceeds that specified limit, find and repair the leaks and repeat the test until successful.

### 3.15 Gravity Sewer Television Inspection

- A. All gravity sewer mains installed shall be inspected by this method in addition to other inspection and testing methods provided for in these specifications.



The work covered by this section consists of providing all labor, equipment, material and supplies and performing all operations required to conduct the internal closed-circuit television inspection of all designated sewer lines. The Contractor shall be responsible for removing his equipment from the sewers and for all associated sewer and restoration repairs necessary as a result of his work.

B. Definitions:

1) Pre-Installation TV Inspection: Pre-installation TV is a video inspection by the Contractor of sewer lines specified for rehabilitation to confirm cleaning, location of service connections, and constructability of line rehabilitation in accordance with the contract documents.

2) Post-Installation TV Inspection: Post-installation TV is a video inspection to determine that rehabilitation and/or replacement of sanitary sewers has been completed in accordance with the contract documents.

3) TV Inspection Log: Information collected and recorded by each TV operator for any TV inspection effort and shall include all pertinent information for the respective inspection section.

4) PACP: Pipeline Assessment and Certification Program. A voluntary CCTV Inspection Standardization certification and observation coding system sponsored by the National Association of Sewer Service Companies (NASSCO).

C. Submittals

Submittals shall be made by the Contractor in accordance with the procedures set forth in the General Conditions, Supplemental Conditions, and Section 01000 - General Requirements, and as described below.

1) Compact Disc (CD), thumb drive or Digital Video Disc (DVD). The storage media shall be specified by the County.

2) TV Inspection Log: Each TV Inspection Log shall be submitted to the County accompanied by the respective video tape.

3) PACP Operator Certification: Prior to initiating CCTV inspection work associated with condition assessment assignments, the Contractor shall present the County with copies of PACP certifications of operators that will be performing the work.

D. Execution

The designated sewer pipe sections shall be televised in accordance with the Contract Documents.

1) Equipment:

a) Closed Circuit TV Equipment - Select and use closed-circuit television equipment that will produce a color CD, DVD or thumb drive.

b) Pipe Inspection Camera - Produce a video using a pan-and-tilt, radial viewing, pipe inspection camera that pans  $\pm 275$  degrees and rotates 360 degrees. The television camera used for the inspection shall be specifically designed and constructed for such inspection. The camera shall be operative in 100% humidity conditions. Use a camera with an accurate footage counter that displays on the monitor the exact distance of the camera (to the nearest tenth of a foot) from the centerline of the starting manhole. Use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being televised. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe. The video camera shall be capable of showing on the digital inspection the County's name, Project name, Contractor name, date, line size and material, line identification (County's manhole numbers at both ends) and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the County; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment. No payment will be made for an unsatisfactory inspection.

E. TELEVISION INSPECTION

1) Flow Control

a) Perform Bypass Pumping when necessary.

b) If during TV inspection of a sewer section, the wastewater flow depth exceeds 20 percent of the inside pipe diameter, reduce the flow depth to an acceptable level by performing the TV inspection during minimum flow hours, bypass pumping, plugging or by pulling the camera with swab, high-velocity jet nozzle or other acceptable dewatering device. Video inspections performed while floating the camera is not acceptable unless approved by the County.

2) Documentation of Television Inspection

a) All Television Inspections shall be documented using a datalogger and reporting system as approved by the County. If a PACP compliant inspection is required, then a PACP compliant datalogger and coding system must be used to perform the work.

b) Television Inspection Logs: Computer printed location records shall be kept by the Contractor and shall clearly show the location and orientation in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations and orientations of service connections, building sewers, unusual conditions, roots, storm sewer cross connections, broken pipe, presence of scale and corrosion, and other discernible features shall be recorded and a copy of such records shall be supplied to the County.

c) Digital Photographs: Noted defects and lateral connections shall be documented as color digital files and color hard copy print-outs. Photo logs shall accompany each photo submitted.

d) Video Recordings: The purpose of video recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Video recordings shall include an audio track recorded by the inspection technician during the actual inspection work describing the parameters of the line being inspected (i.e location, depth, diameter, pipe material), as well as describing connections, defects and unusual conditions observed during the inspection. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Once inspected, the CDs/DVDs or thumb drive shall be labeled and become the property of the County. The Contractor shall have all video and necessary playback equipment readily accessible for review by the County during the project.

3). Pre-Installation Inspection for Sewer Lines to be Rehabilitated

a) Perform pre-installation TV inspection immediately after line cleaning and before line rehabilitation work. Pre-installation TV inspection is not required for sewer lines designated as remove and replace or point repair only.

b) The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

- c) If, during the inspection operation, the television camera will not pass through the entire pipe section due to blockage or pipe defect, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire pipe section, the inspection shall be considered complete and no additional inspection will be required at that time. Improper cleaning will not be a reason for incomplete televising of a line section.
- d) When manually operated winches are used to pull the television camera through the line, hand operated radios, telephones, or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communication between members of the crew.
- e) During the internal inspection, the television camera shall be temporarily stopped at each defect along the line. The nature, location, and orientation of the defect shall be recorded by the Contractor. Where defects are also active infiltration sources, the rate of infiltration in gallons per minute shall be estimated by the Contractor and recorded. The camera shall also be stopped at all service connections and identified by footage and clock orientation.
- f) The camera operator shall slowly pan and tilt at beginning and ending manhole connections, each service connection, joints, visible defects, and at pipe material transitions.
- g) TV inspections shall be continuous for pipe segments between manholes. Do not show a single segment on more than one CD/DVD or thumb drive unless specifically approved by the County.

#### 4) Post - Installation Inspection

- a) Post-installation TV inspection shall not be completed until all work, including main line and manhole visual, pressure testing, deflection and leakage testing is complete on a section of line.
- b) Post-installation TV inspection shall be completed by the Contractor in the presence of the County representative.
- c) The post-installation TV inspection shall be completed to confirm that rehabilitated lines are free of defects. Provide a color video showing the completed work. Prepare and submit Television Inspection Logs providing location of service connections along with location of any discrepancies.

Manhole work, including benches, inverts and pipe penetrations into manhole, should be complete prior to post-installation TV work.

d) For post-installation TV inspection, exercise the full capabilities of the camera equipment to document the completion and the conformance of the work to the Contract Documents. Provide a full 360-degree view of pipe, joints and service connections.

e) The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

f) When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communication between members of the crew.

g) The importance of accurate distance measurements is emphasized. The meter device shall be accurate to one tenth of a foot.

h) TV inspections shall be continuous for pipe segments between manholes. Do not show a single segment on more than one CD/DVD or thumb drive unless specifically allowed by the County.

i) Prior to inserting the television camera into the pipeline, the Contractor shall flush and clean the pipeline with clear, potable water into the terminal upstream manhole or last access structure on any given gravity sewer branch of the pipeline to be inspected with a television camera. The Contractor is responsible for acquiring, collecting and disposing of the water, at no cost to the County.

#### 5) Acceptance of Television Inspection Results

a) Television inspection results will be accepted by the County when the video and inspection logs meet the requirements of this specification section.

END OF SECTION